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# (12) EUROPEAN PATENT APPLICATION

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## (54) Data distribution systems

(57) An in flight entertainment system (2) for an aircraft comprises an asynchronous transfer mode network which encodes, carries, switches, and delivers entertainment services as digital data streams. Services provided by the system are video, audio, announcements, data provision, systems controls, telephony and games. The network comprises copper and optical fibre (70, 72) links.

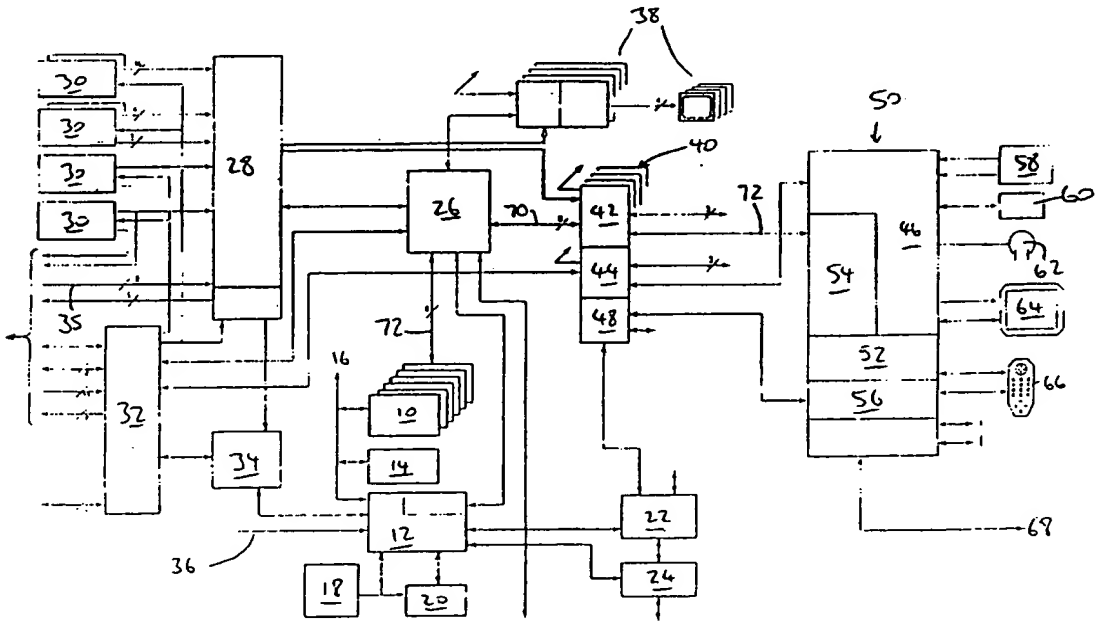


FIGURE 2.

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Figure 4 shows another part of the system of Figures 1 and 2.

Figure 1 shows a schematic representation of an IFE system 2. The system is in a three tier arrangement having a head end 4, a number of zones 6 and seat ends 8 within each zone 6.

The system 2 is shown in greater detail in Figure 2 and comprises a video file server (VFS) 10 controlled by a cabin file server 12. The VFS 10 and cabin file server 12 are connected over an ethernet LAN which is in turn connected at 16 to one or more attendants' work stations 14 and other terminals. The cabin file server 12 is supported by a disc drive unit 20.

In order to supply VOD and AOD data streams the system 2 uses digital transmission of information to provide a fully digital random access server platform which permits stored compressed video and audio data and allows multiple, simultaneous random accesses to be made to that data. The system 2 uses direct time division multiplexing of the compressed digital data streams from the VFS into high speed digital streams which are then distributed in baseband form via switches to the seats over a digital network. The system 2 uses a full duplex, bi-directional asynchronous transfer mode (ATM) distribution network which is capable of carrying integrated real time video/audio communications simultaneously with PC type computer communications and control information all over the same physical network.

It is advantageous to use ATM transmission because it offers a compact and integrated system which can be readily expanded.

In one embodiment the VFS 10 may be modular comprising a plurality of mini-servers rather than employing a single larger server unit. This provides a greater degree of fault tolerance and capability in scaling up or down to suit a wide variety of aircraft types and airline requirements. Furthermore a number of smaller units are easier to accommodate on an aircraft.

Each VFS 10 is a self contained unit fitted within a single 8-MCU enclosure including a small disk drive array (having a memory capacity of 32 Gbytes in total), a server processor, an ATM interface and a power supply. Using an MPEG-2 compressed video format each VFS 10 is capable of storing approximately 30 hours of multilingual video audio programming content and delivering approximately 50 simultaneous VOD and AOD streams. More than 30 hours of programming content may be possible using an MPEG- 1 format. A typical aircraft installation employs between 4 and 8 VFS units.

The cabin file server 12 is connected to communications systems such as a cabin telecom unit 22 and a satellite data unit 24, which themselves are interconnected. The satellite data unit 24 is connected to off-aircraft communications.

An input 36 feeds navigation data into the cabin file server 12 to provide flight information to passengers.

Each VFS 10 is connected to an asynchronous transfer mode switching unit (ATM switch) 26. The ATM switch is a central node in the system and controls switching of data streams about the system 2 and ultimately to passengers. A video audio compression unit 28 supplies the ATM switch with compressed digital video/audio signals, converted from live video/audio and residual analogue player sources 30. These analogue signals may include pre-recorded announcements, boarding music and other analogue audio sources. The compression unit 28 is MPEG-1 based. Alternatively, it is a feature of the present invention that the systems for generating the pre-recorded announcements and boarding music may be incorporated into the VFS 10.

Aircraft systems other than the IFE system interface through the compression unit 28 and also through an aircraft interface unit (AIU) 32. This incorporates all of the interfaces required to manage the interface between the IFE and the aircraft systems. The AIU is the focal point for all control message functions and interfaces directly to a cabin system control panel 34 to provide interactive control and reporting.

A serial data link between the cabin system control panel and the compression unit 28 enables public address (or passenger address) and video announcements to be controlled. Analogue audio signals to and from the aircraft public address side are routed directly along link 35 to the compression unit 28 rather than through the AIU in order to limit cable and connector losses and to simplify the aircraft wiring.

The VFS 10 or the compression unit 28 supplies compressed digital video streams to an overhead video unit 38 which supplies baseband video to up to four monitors. Typically there is at least one overhead unit per zone. There may be more than one. The video streams are sent via the ATM switch 26. A fully populated ATM switch supports up to 8 x 622 Mbits/sec ATM ports and 12 x 155 Mbits/sec ports. The unit comprises a central routing management processor and parallel backplane based switching network, together with a number of 2-port and 4-port interface cards. The switch management and routing control software is embedded within the ATM switch.

Features 10 to 36 comprise the head end which interfaces with the aircraft systems.

Data streams supplied through ATM switch 26 are switched through a zone switching unit 40.

The ATM switch is connected to eight zone switching units 40. The zone switching unit comprises a zone ATM switch 42, a zone passenger service system control 44 and a zone telecom module 48. The zone passenger service system control 44 is responsible for such services as attendant call and reading light. This control is separate from the ATM network because of flight safety and redundancy considerations.

Inputs from the ATM switch 26 and AIU 32 feed into the zone ATM switch 42 which demultiplexes the data streams which are received. The zone ATM switch 42 demultiplexes and remultiplexes passenger data

er 12 are linked by an ATM link 84 at 155 Mbit/sec.

The ATM switch 26 also receives data from other sources such as the compression unit 28 (at 155 Mbit/sec over ATM) and aircraft interface unit 32 (at 25 Mbit/sec over ATM) and sends data to the overhead video units 38. The data can include video, audio, voice, computer data and control messages. The received signals are demultiplexed and remultiplexed to be transmitted at 622 Mbit/sec over an optical fibre link 86 to the zone switching unit 40. This demultiplexes and then remultiplexes into 155 Mbits/sec column streams which are directed over optical fibre links 88 to a seat column and then onto an interactive seat unit 50. In addition other connections including a power connection 90 and a RS-485 link 92 carrying passenger service system and passenger address information link the zone switching unit 40 to the integrated seat unit 50. The PSS/PA link 92 feeds directly into the video audio control module 46.

The daisy chain linking from the zone switching units 40 to integrated seat units 50 and between adjacent integrated seat units is a combination of optical fibre (carrying VOD/AOD streams) and copper (carrying power and PSS/PA at 100K bit/sec). An advantage of carrying PSS/PA data over copper is that it is separate from the VOD/AOD data streams and thus, where necessary, may override these data streams for presenting general information to all of the passengers, for example emergency or instructional information. VOD/AOD, PSS/PA and power may be carried over separate cables or a single cable assembly may carry optical fibre, power and PSS/PA. However, it may only carry optical fibre and one of the other functions such as power. In any event the connectors connecting to integrated seat units may be combined optical fibre and copper connectors. A daisy chain arrangement between different integrated seat units is advantageous because in different applications, such as different aircraft, the pitch between successive seat columns may differ. Therefore the system is flexible and may readily be adapted to differing seating configurations.

The daisy chains link through ATM switches which include active repeaters in the modules 54 to allow for connector losses which may occur between adjacent units 50. This also allows lower optical power levels to be used than would otherwise be required.

An integrated seat unit 50 is shown in greater detail in Figure 4. The links between the ATM switch module and the other SPMs 52 are at 25 Mbits/sec.

The ATM switch module 54 has three dedicated connections to SPMs which provide dedicated network addresses for each SPM. This avoids sharing single network addresses with multiple SPMs. This provides a one to one relationship between each passenger's SPM and the cabin file server, thus allowing use of industry standard network software rather than requiring software which must be specially tailored or written, such as additional protocol layers.

Although the description has referred to use of the system in an aircraft, it is intended that the system may be used in other applications including automobiles, such as coaches, trains, and waterborne craft, such as a hovercraft.

## Claims

1. An entertainment system (2) to be used in a mode of transportation comprising an asynchronous transfer mode network.

2. A system (2) according to claim 1 in which the entertainment services provided by the network are provided in a digital format.

3. A system (2) according to claim 1 or claim 2 in which digital data is switched by a central asynchronous transfer mode switch (26).

4. A system according to any preceding claim which is served by a stored data source (10).

5. A system (2) according to any preceding claim in which the network comprises optical fibre links (70, 72).

6. A system (2) according to any preceeding claim in which individual seat groups are connected by optical fibre links (72).

7. A system (2) according to any preceding claim in which at least two switching nodes (54) in the network are linked in a daisy chain arrangement (68).

8. A system (2) according to any preceding claim in which the network is a three tier (4, 6, 8) hierarchy.

9. A system according to claim 8 in which the tiers are a central or head tier (4), a zone tier (6) and a seat tier (8).

10. A system (2) according to any preceding claim in which the mode of transportation is an aircraft.

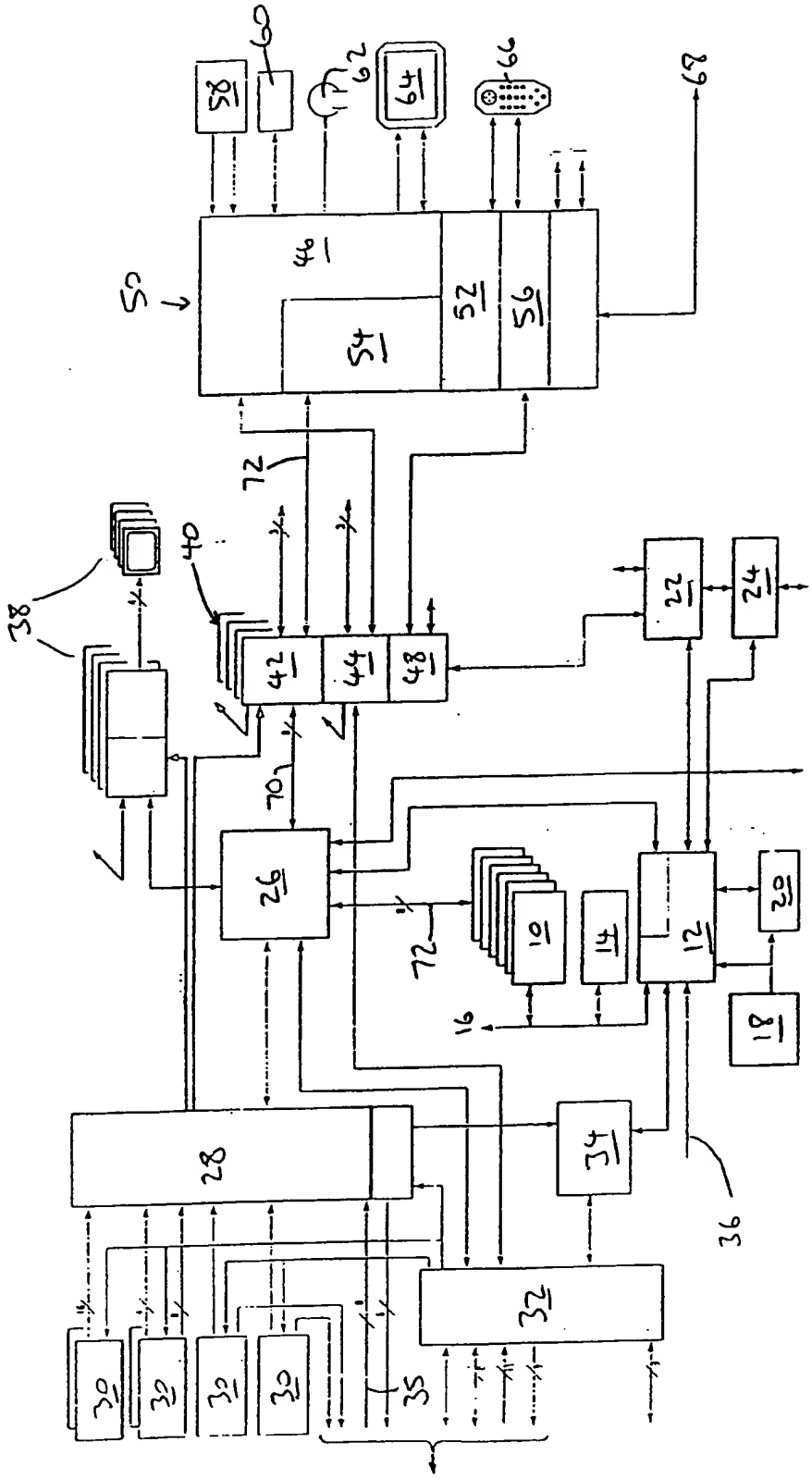
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FIGURE 2.

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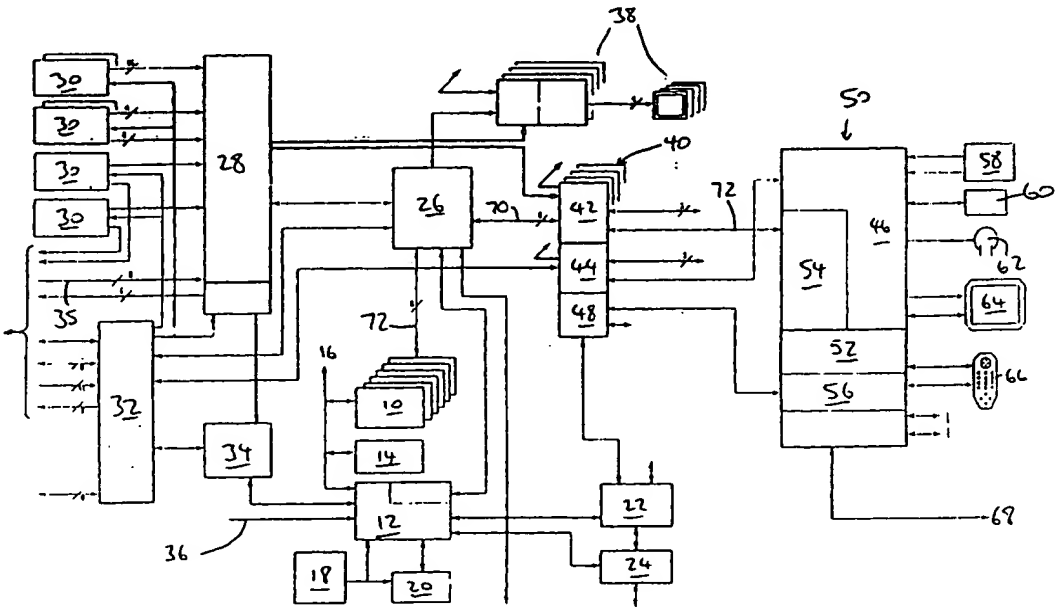


FIGURE 2.

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## CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

☐ All claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for all claims.

☐ Only part of the claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid,

namely claims:

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

## LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirement of unity of invention and relates to several inventions or groups of inventions.

namely:

See sheet B.

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid.

namely claims:

☒ None of the further search fees has been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims.

namely claims: 1-3, 10